FMOSCPW60N65-Q1-H

List

FMOSCPW60N65-Q1-H

60A 650V N-Channel Enhancement Mode Silicon Carbide Power MOSFET

Features

- V_{DS} = 650V, I_D = 60A.
- $R_{DS(ON)}$ ≤ 65mΩ, @ V_{GS} = 20V, I_D = 20A.
- Low on-resistance and high current density.
- Low capacitance for high frequency operation.
- Ultra-high avalanche ruggedness.
- Positive temperature coefficient device.
- Qualified to AEC-Q101 standards for high reliability.
- Lead-free parts meet RoHS requirements.
- Halogen-free (IEC61249-2-21).

Applications

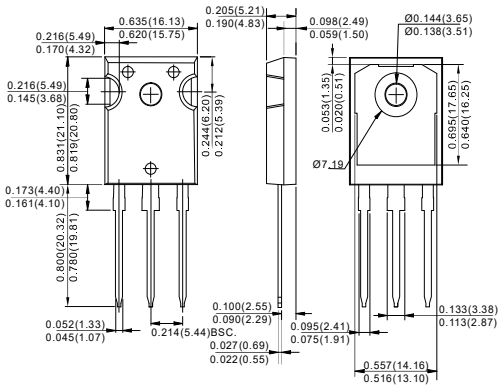
- Solar/ wind renewable energy, and power inverters.
- DC/DC converters, UPS, and PFC.
- Switched mode power supplies, EV charging station, and motor drives.

Mechanical data

- Epoxy:UL94-V0 rated flame retardant.
- Case : Molded plastic, TO-247.
- Terminals : Solder plated, solderable per MIL-STD-750, Method 2026.
- Mounting Position : Any.

Package outline

TO-247



Dimensions in inches and (millimeters)

Maximum ratings (At T_C=25°C unless otherwise specified)

Parameter		Symbol	Ratings	Unit
Maximum drain to source voltage	(V_{GS}=0V, I_D=100μA)	V_{DS}	650	V
Recommend Gate-source voltage	Static, recommended DC operating values	$V_{GS(OP)}$	-5 to +20	V
Maximum Gate-source voltage	Transient operating limit (AC f >1Hz, duty cycle <1%)	$V_{GS(Max)}$	-10 to +25	V
Continuous drain current ,@V_{GS}=20V	(T_C=25°C)	I_D	60	A
	(T_C=110°C)		41	
Pulsed drain current, t_{PW} limitation per Fig.15		$I_{D(pulse)}$	169	A
Avalanche energy, single pulse	(V_{DD}=100V, I_D=10A)	E_{AS}	1.6	J
Power dissipation	(T_C=25°C)	P_D	250	W
Mounting torque	(M3 or 6-32 screw)	M_d	1	Nm
Typical thermal resistance, junction to case		$R_{\theta JC}$	0.6 (Typ.)	°C/W
Soldering temperature		T_L	260	°C
Junction temperature		T_J	+175	°C
Storage temperature range		T_{STG}	-55 to +175	°C

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Electrical characteristics (At T_C=25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Off characteristics						
Drain-source breakdown voltage	BV_{DSS}	I_D=100μA, V_{GS}=0V	650			V
Drain-source leakage current	I_{DSS}	V_{DS}=650V, V_{GS}=0V		<1	50	μA
		V_{DS}=650V, V_{GS}=0V, T_J=175ºC		10	500	
Gate-source leakage current	I_{GSS}	V_{GS}=20V, V_{DS}=0V			250	nA
On characteristics						
Gate threshold voltage	$V_{GS(TH)}$	V_{DS}=10V, I_{DS}=20mA	1.5	2.6	4.5	V
Static drain-source on-state resistance	$R_{DS(ON)}$	V_{GS}=20V, I_{DS}=20A		50	65	mΩ
		V_{GS}=20V, I_{DS}=20A, T_J=175ºC		65		
Transconductance	g_{FS}	V_{DS}=15V, I_{DS}=40A		13.2		S
Dynamic parameters						
Input capacitance	C_{iss}	V_{GS}=0V, V_{DS}=400V, f=1.0MHz,V_{AC}=25mV		1850		pF
Out capacitance	C_{oss}			208		
Reverse transfer capacitance	C_{rss}			33		
Effective output capacitance, energy related	$C_{o(er)}$	V_{GS}=0V, V_{DS}=0 to 400V		237		
Effective output capacitance, time related	$C_{o(tr)}$	I_D=const. , V_{GS}=0V, V_{DS}=0 to 400V		305		
C_{OSS} Stored energy	E_{OSS}	V_{GS}=0V, V_{DS}=400V, f=1.0MHz,V_{AC}=25mV		24		μJ
Turn-on switching energy	E_{ON}	V_{DS}=400V, V_{GS}=0/+20V, I_D=20A, $R_{G(ext)}$=2.7Ω		131		
Turn-off switching energy	E_{OFF}			40.3		
Internal gate resistance	$R_{G(int)}$	f=1.0MHz,V_{AC}=25mV		1.2		Ω
Gate to source charge	Q_{gs}	V_{DS}=400V, V_{GS}=-5V/+20V, I_D=30A		30		nC
Gate to drain charge	Q_{gd}			43		
Total gate charge	Q_g			121		
Gate plateau voltage	V_{pl}			8.8		V
Short- circuit withstand time	t_{sc}	V_{GS}=0/15V , V_{DS}=400V, R_G=100Ω		<18		μs
Turn-on delay time	$t_{d(on)}$	V_{DS}=400V, V_{GS}=-4V/+20V, I_D=20A, R_L=20Ω, $R_{G(ext)}$=2.7Ω		16		ns
Rise time	t_r			17		
Turn-off delay time	$t_{d(off)}$			20		
Fall time	t_f			10		
Built-in SiC diode characteristics						
Diode forward voltage	V_{SD}	I_{SD}=5A, V_{GS}=0V		3		V
Diode continuous current	I_S	V_{GS}=0V, T_C=25°C		42.5		A
Peak reverse recovery current	I_{rrm}	V_{GS}=0V, I_{SD}=30A, V_{DS}=400V, di/dt=300A/μs		3.75		A
Reverse recovery time	t_{rr}			58		ns
Reverse recovery charge	Q_{rr}			122		nC

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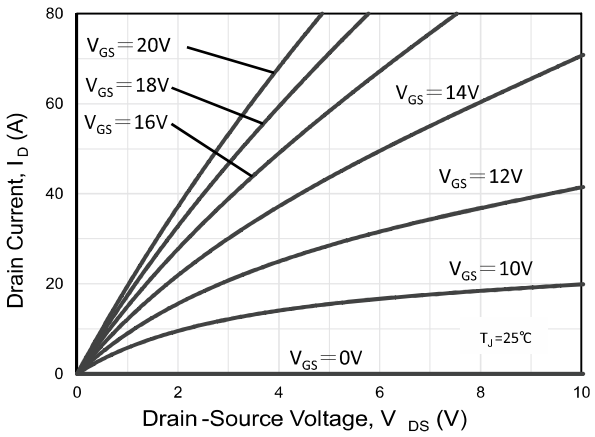
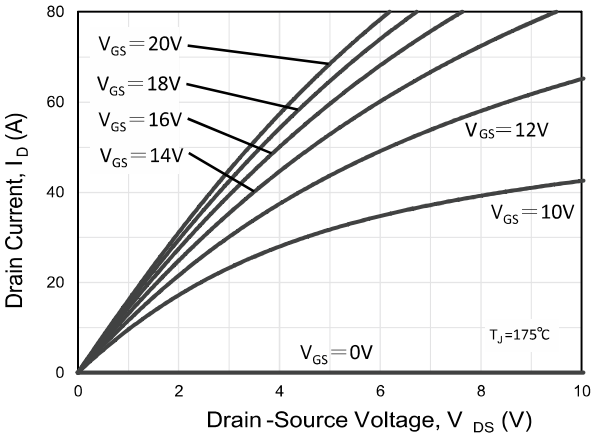
Rating and characteristic curves

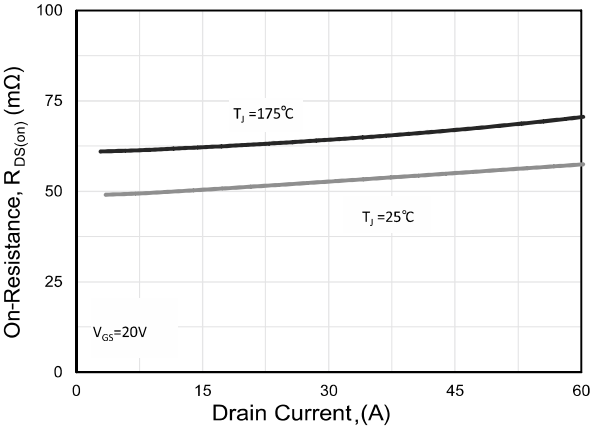
Forward output characteristics at T_J=25ºC



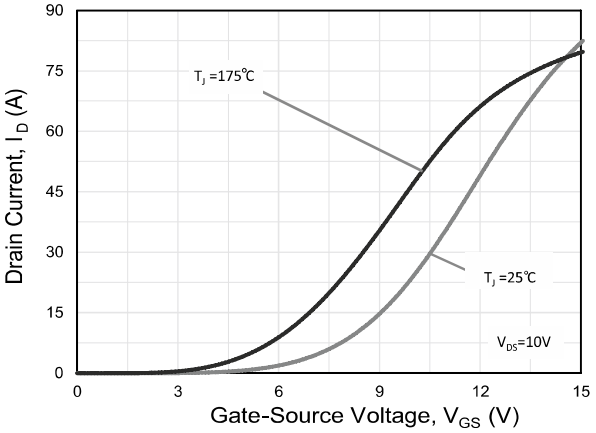
Forward output characteristics at T_J=175ºC



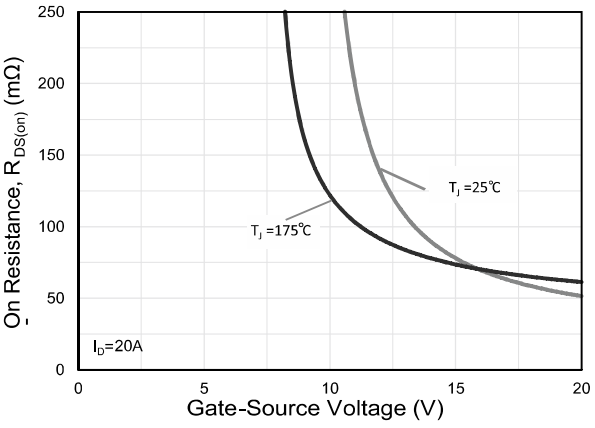
On-resistance vs. Drain current



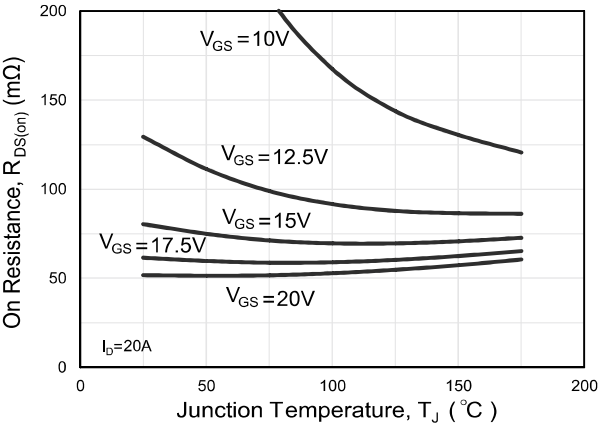
Transfer characteristics



On-resistance vs. Gate voltage



On-resistance vs. Junction temperature



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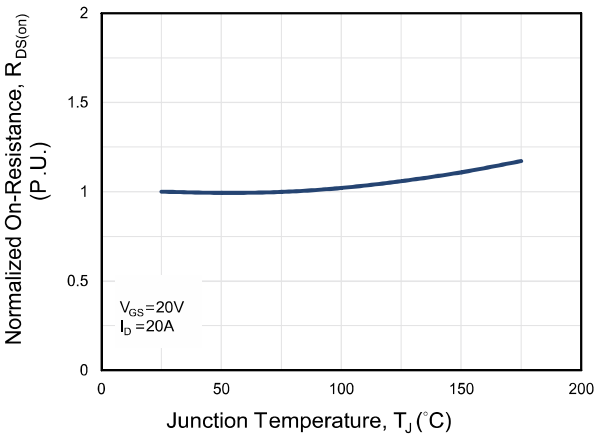
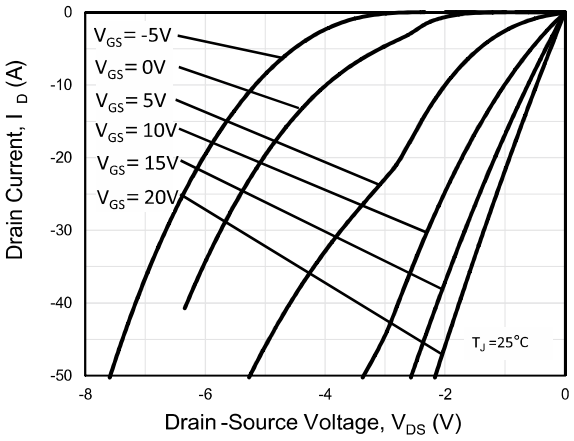
Rating and characteristic curves

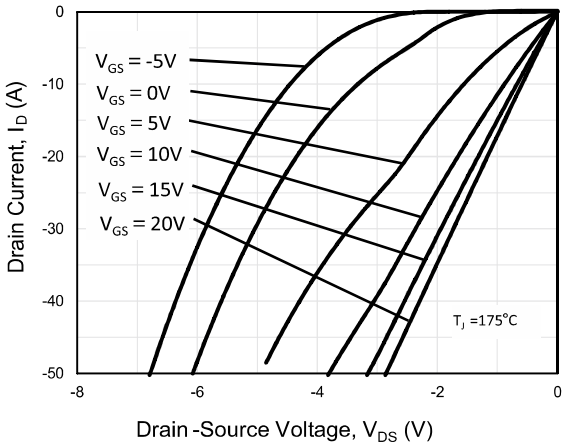
Normalized on-resistance vs. Junction temperature



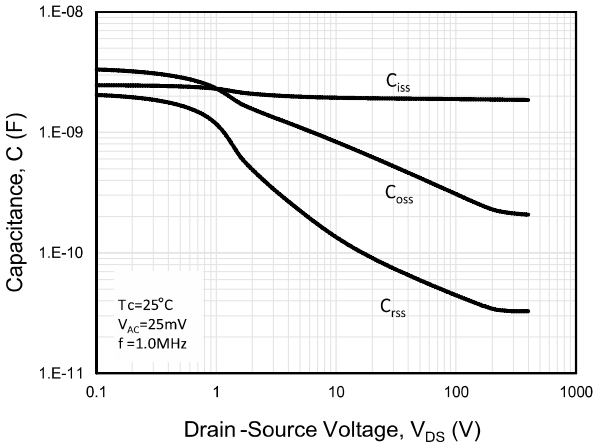
Reverse output characteristics at T_J=25ºC



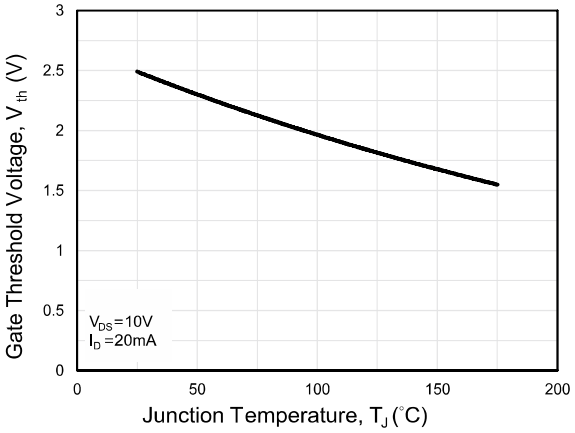
Reverse output characteristics at T_J=175ºC



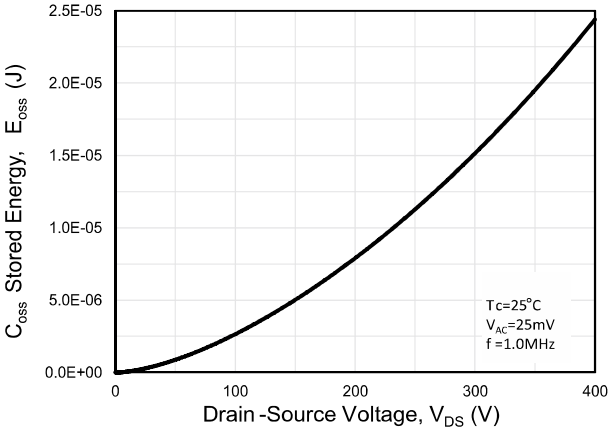
Capacitances vs. Drain-source voltage



Threshold voltage vs. Junction temperature



Output capacitor stored energy



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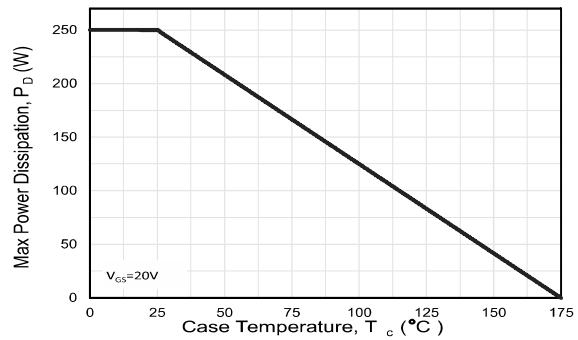
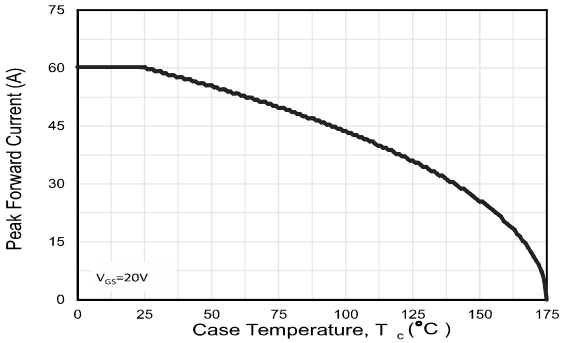
Rating and characteristic curves

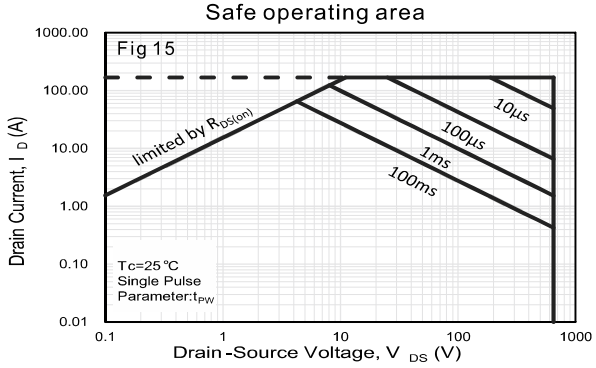
Maximum power dissipation de-rating vs. Case temperature



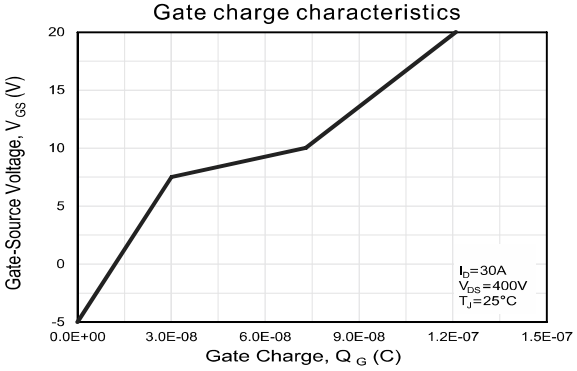
Drain current de-rating vs. Case temperature



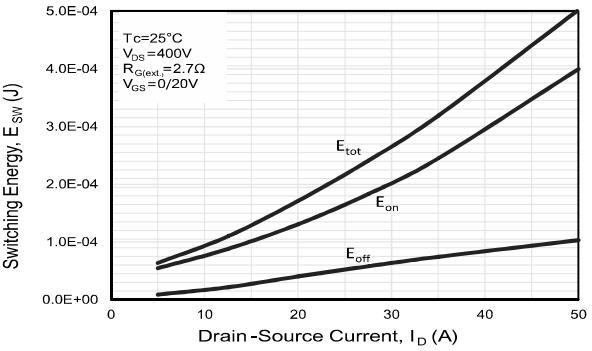
Safe operating area



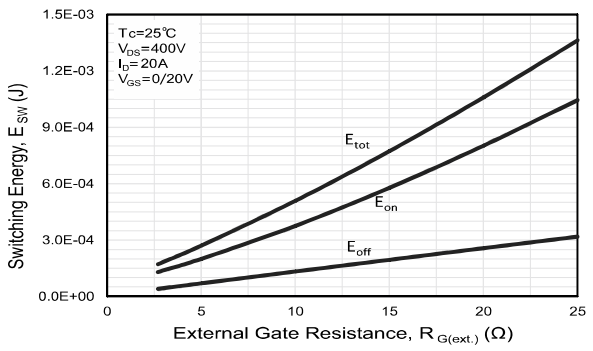
Gate charge characteristics



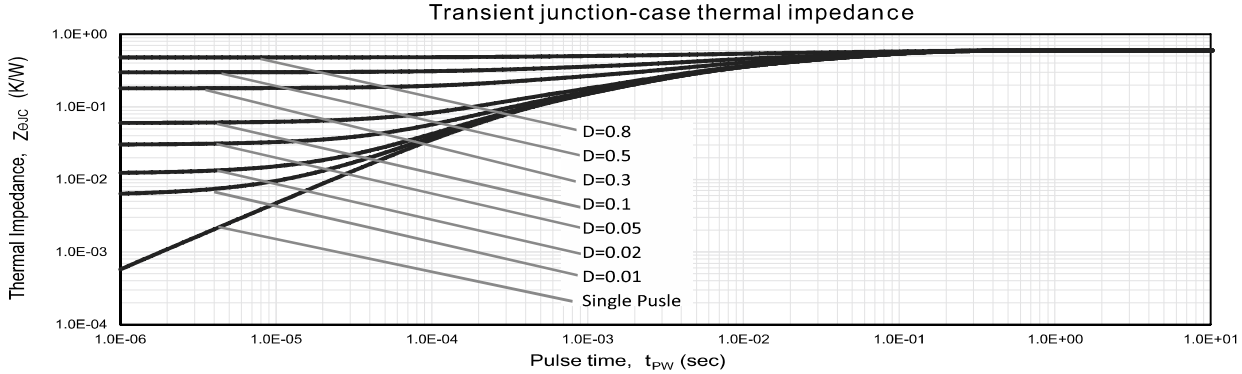
Clamped inductive switching energy vs. Drain current



Clamped inductive switching energy vs. External gate resistor($R_{G(ext.)}$)



Transient junction-case thermal impedance



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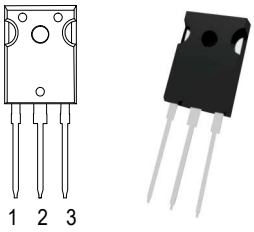
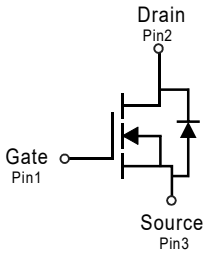
Pinning information

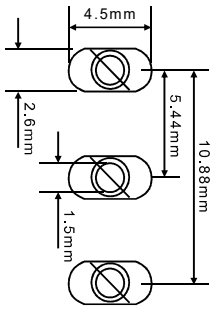
Pin	Simplified outline	Symbol
Pin 1 Gate Pin 2 Drain Pin 3 Source		

Marking

Type number	Marking code
FMOSCPW60N65-Q1-H	CPW60N65

Suggested solder pad layout

TO-247



Dimensions in millimeters

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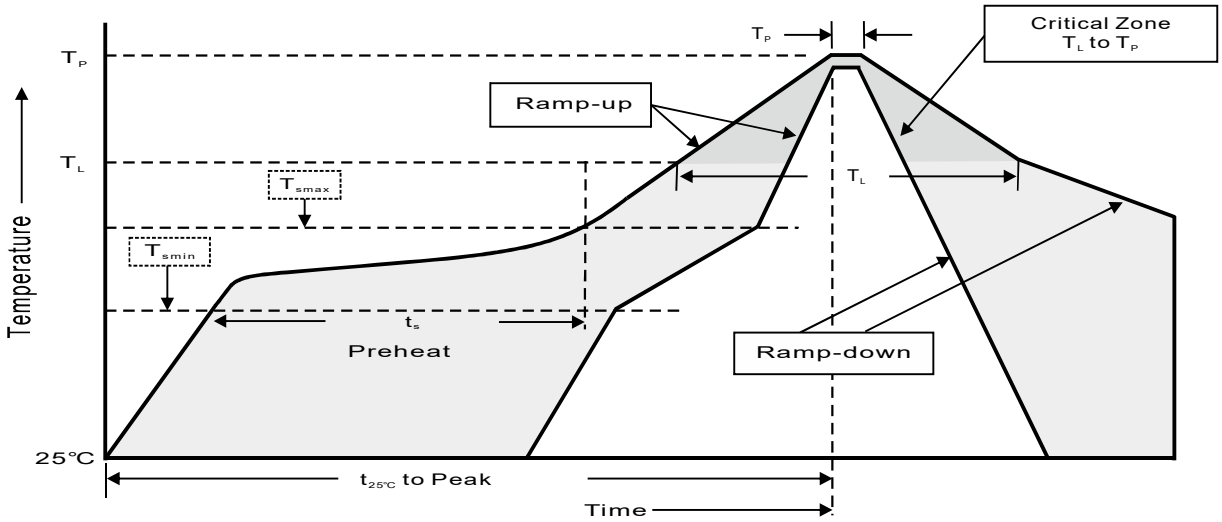
Suggested thermal profiles for soldering processes

1.Storage environment: Temperature = 5°C ~ 40°C Humidity = 55%, ±25%

2.Reflow soldering of surface-mount devices



3.Reflow soldering

Profile feature	Soldering condition
Average ramp-up rate (T_L to T_P)	< 3 ℃/sec
Preheat - Temperature Min (T_{smin}) - Temperature Max (T_{smax}) - Time (Min to Max) (t_s)	 150℃ 200℃ 60 ~ 120 sec
T_{smax} to T_L - Ramp-up rate	 < 3 ℃/sec
Time maintained above : - Temperature (T_L) - Time (T_L)	 217℃ 60 ~ 260 sec
Peak temperature (T_P)	255 ℃ -0/+5℃
Time with 5℃ of actual peak temperature (T_P)	10 ~30 sec
Ramp-down rate	< 6 ℃/sec
Time 25℃ to peak temperature	< 6 minutes

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High reliability test capabilities

Item Test	Conditions	Reference
1. MSL Preconditioning	24hr bake@125°C+168hrs@85°C /85%RH+3xIR@260°C+1flux immersion+alcohol+DI H2O rinse	JESD22-A113
2. High Temperature Reverse Bias	V_{DS}=V_{DS}*80% (T_J=T_J max.)Test Duration:1000hrs	JESD22-A108
3. High Temperature Storage Life	Ta=150°C Test Duration:1000hrs	JESD22 A-103
4. Temperature Cycle	-55°C(15min) to 150°C(15min)Test Cycles:1000cycles	JESD22 A-104
5. Autoclave	P=2atm Ta=121°C RH=100% Test Duration:96hrs	JESD22 A-102
6. Solderability	245±5°C for 5sec	J-STD-002
7. Moisture Resistance	Ta=85°C/85% Relative humidity Test Duration:1000hrs	MIL-STD-750E METHOD 1021.2
8. Resistance To Solder Heat	260±5°C for 10sec	JESD22 B-106
9. High Temperature High Humidity Reverse Bias	Ta=85°C, 85%RH, V_{DS}=80% ratedV_{DS} Test Duration: 1000hrs	JESD22-A101